AN3996
Application Note

Adjustable LED blinking speed using STM8SVLDISCOVERY

Application overview

This application note provides a short description of the demonstration firmware Discover which is preprogrammed in the Flash memory of the STM8S003K3T6 microcontroller.

This demonstration firmware makes use of the STM8S basic 8-bit timer configured as a time-base generator to change the blinking speed of LED LD1 each time the push button B1 is pressed. Once the STM8SVLDISCOVERY is powered-up through a standard USB cable connected to the host PC, LED LD1 starts blinking slowly, meaning that the programming has been completed successfully.

This demonstration software is available from http://www.st.com/stm8svldiscovery.
It is provided to allow you to learn, reuse and modify the application source code.

Built around the STM8S003K3T6, the STM8SVLDISCOVERY allows evaluation of the main features of all the STM8S00xxx line MCUs.

Reference documents

- STM8SVLDISCOVERY user manual (UM1482).
- STM8SVLDISCOVERY getting started (UM1480)
- Developing and debugging your STM8S-DISCOVERY application code user manual (UM0834).
- STM8S003 datasheet
- STM8S reference manual (RM0016)

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1 Application description

1.1 Hardware required

The following STM8SVLDISCOVERY on-board resources are used:

- LED, LD1
- User push button, B1

No additional hardware is required to make this application software run on the STM8SVLDISCOVERY.

1.2 Application schematics

Refers to UM1482 STM8SVLDISCOVERY for implementation details.

1.3 Application principle

This application uses the 8-bit timer TIM4 as a time-base generator to control LED LD1 blinking speed. Each time the STM8S Value microcontroller detects an event on push button B1, the delay (a multiple of the TIM4 time-base) between each toggle of the LED is adjusted to change the blinking frequency accordingly.

At application start-up, the blinking period is configured to 1 second and LD1 toggles at this rate (every second). This configuration allows to check visually that the STM8S Flash memory was successfully programmed.

Each time a push button event is detected on B1, LD1 blinking frequency is increased according to the settings described in *Table 1*. At the third press, the LED is switched off. You can then restart the blinking cycle.

Table 1. LED LD1 configuration

Push button B1	LD1	Toggling period
At application start-up (only)	Toggles	1 sec
1st press	Toggles	200 ms
2nd press	Toggles	100 ms
3rd press	Switched off	N/A

2 Software description

The application software uses the STM8S standard firmware library to control general purpose functions and peripherals:

- Clock (CLK)

  The clock control enables and delivers the correct clock frequency to the CPU and peripherals. At power-on, the master clock source is automatically selected as HSI clock with prescaler division factor equal to 8, This setup is not changed by the application code:
  f_{MASTER} = 2 MHz.
- GPIOs

  The GPIOs drive the MCU I/Os to interface with external hardware. They configure port PD0 as output push-pull low to drive LED LD1, and PB7 as input floating with external interrupt to interface with the push button B1. This interrupt is controlled by the Interrupt Controller.
- EXTI

  The external interrupt controller is configured to control the external interrupt sensitivity on the push-button connected to PB7. It is configured to trigger an interrupt each time a falling edge (and only a falling edge) is detected on PB7.
- TIM4

  TIM4 is a basic 8-bit timer used as a 4 ms time base. This time base is used by the application to control LD1 blinking speed. TIM4 is configured by the application as follows:
  - Up Counting mode
  - TIM4_PSCR = 5 => Counting frequency is 62.5 KHz
  - Fck_cnt = f_{MASTER}/2^PSCR[2:0]
  - TIM4_ARR = 0xFA (250 cycles)

2.1 STM8S standard firmware library configuration

The *stm8s_conf.h* file of the STM8S standard firmware library is used to configure the library by enabling the peripheral functions used by the application.

The following define statements must be present:

- `#define _GPIO 1` enables GPIOs
- `#define _EXTI 1` enables EXT1
- `#define _TIM4 1` enables TIM4

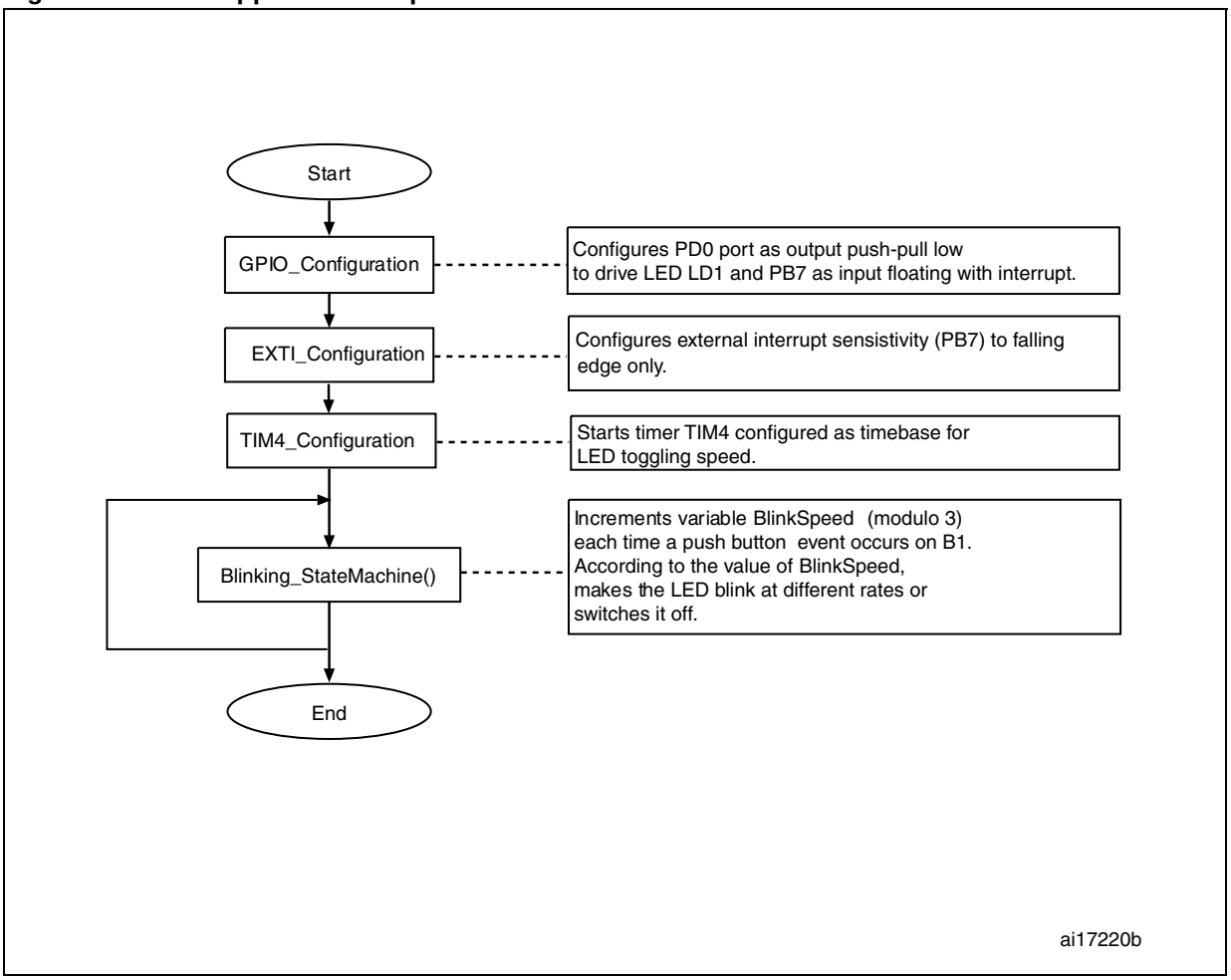
2.2 Application software flowcharts

This section gives an overview of the application software main loop as well as of the function that controls LD1 blinking speed.

2.2.1 Main loop flowchart

Figure 1 shows the flowchart of the application software main loop.

Figure 1. Main application loop flowchart


Start
GPIO_Configuration
Configures PD0 port as output push-pull low
to drive LED LD1 and PB7 as input floating with interrupt.
EXTI_Configuration
Configures external interrupt sensistivity (PB7) to falling
edge only.
TIM4_Configuration
Starts timer TIM4 configured as timebase for
LED toggling speed.
Blinking_StateMachine()
Increments variable BlinkSpeed (modulo 3)
each time a push button event occurs on B1.
According to the value of BlinkSpeed,
makes the LED blink at different rates or
switches it off.
End
ai17220b

2.2.2 Blinking_StateMachine flowchart

Figure 2 shows the detailed flowchart of the `Blinking_StateMachine()` function part of the main routine.

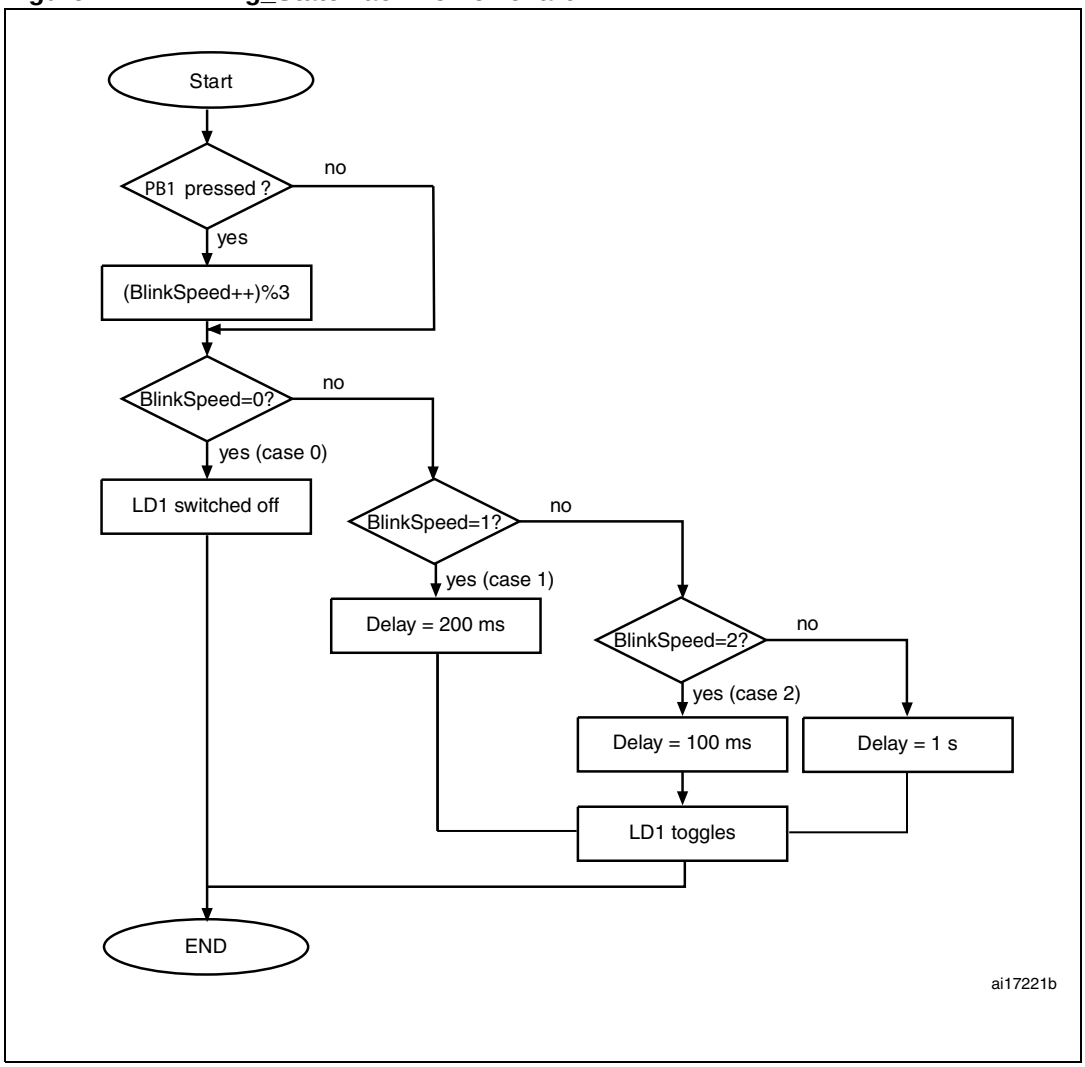
The `Blinking_StateMachine()` function implements the algorithm that controls the LED blinking speed depending on the state selected by the push button.

At application start-up, the state machine is in its default state, LD1 toggles every 1 s period, then `BlinkSpeed` is incremented at each push button detection. In state 1 and state 2 of the state machine, the programmed blinking frequency is changed and LD1 is switched-off in state 0.

LED LD1 blinking frequency is defined using the 8-bit timer TIM4 configured as a time-base generator to assert an update interrupt every 4ms.

The toggling period depends on the value of `PeriodNumber`. This variable defines the number of times the timer interrupt is to be asserted (reach overflow) before toggling the LED LD1. As a result, LED blinking frequency can only be a multiple of 4 ms (see *Table 1*).

Figure 2. Blinking_StateMachine flowchart



3 Revision history

Table 2. Document revision history

Date	Revision	Changes
31-Oct-2010	1	Initial release.

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